In the Claims

1. (Currently amended) A diagnostic method for high sensitivity detection of component concentrations in human gas emissions comprising:

(a) collecting a gas sample in a gas cell, wherein the gas sample may contain a specified component being associated with a plurality of fundamental absorption peak frequencies, and placing the gas cell in an optical cavity;

(b) passing, at distinct and different times, a tunable optical radiation beam at a first frequency and at a second frequency through the gas cell when the gas cell (1) contains a reference sample having a known concentration of the specified component, (2) does not contain the specified component, and (3) contains the gas sample, wherein the first frequency corresponds to one of the fundamental absorption peak frequencies and the second frequency does not correspond to one of the fundamental absorption peak frequencies;

(c) measuring, after the tunable optical radiation beam passes through the gas cell, as signal outputs an optoacoustic signal in the gas cell detected by an acoustic microphone, and as a second signal outputs a power of the tunable optical radiation beam; and

(d) determining a concentration of the specified component in the gas sample using the signal outputs obtained at the first frequency and the second frequency.

2. (Original) The method of claim 1, wherein the gas sample is collected from expired human breath.

3. (Original) The method of claim 1, wherein the gas sample is collected from gas emissions from human skin.'

4. (Original) The method of claim 3, wherein the step of collecting the gas sample further comprises:

(a) sealing a collection chamber having a first side with a planar opening by placing the first side firmly against skin;

(b) delivering into the collection chamber a steady flow of an inert gas; and

(c) collecting the gas sample from the collection chamber into the gas cell.

5. (Original) The method of claim 1, wherein the specified component is ammonia.

6. (Original) The method of claim 1, wherein the specified component is nitric oxide.

7. (Original) The method of claim 1, wherein the specified component comprises a ketone.

8. (Original) The method of claim 1, wherein the specified component comprises an alcohol.

9. (Original) The method of claim 1, wherein the specified component comprises an alkane.

10. (Original) The method of claim 1, wherein said tunable optical radiation beam is multiplexed so that the beam may be passed through one or more of the gas cells.

11. (Original) The method of claim 10 further comprising detecting when a patient connects to one of the plurality of gas cells, said patient providing the gas sample.

12. (Original) The method of claim 10 further comprising notifying a patient when to connect to one of the plurality of gas cells, said patient providing the gas sample.

13. (Original) The method of claim 10 further comprising notifying the patient of a completed diagnosis after determining the concentration of the specified component.

14. (Original) The method of claim 10 further comprising the tunable optical radiation beam being simultaneously passes through at least two of the plurality of gas cells.

15. (Currently amended) A diagnostic method for high sensitivity detection of component concentrations in human gas emissions comprising:

(a) collecting a gas sample in a gas cell, wherein the gas sample may contain a specified component being associated with a plurality of fundamental absorption peak frequencies;

(b) passing a tunable optical radiation beam through the gas cell when the gas cell (1) contains a reference sample having a known concentration of the specified component and (2) contains the gas sample, wherein the frequency of the tunable optical radiation beam comprises a modulation frequency superimposed on a base frequency, and the base frequency is swept repeatedly through a series of frequencies such that the series of frequencies comprises at least one of the fundamental absorption peak frequencies;

(c) measuring, after the tunable optical beam passes through the gas cell, as first signal outputs the amplitude of an optoacoustic signal in the gas cell detected by an

acoustic microphone, and as a second signal of the tunable optical radiation beam at the modulation frequency, and as second signal outputs a power of the tunable optical radiation beam; and

(d) determining a concentration of the specified component in the gas sample using the first signal outputs and the second signal outputs obtained from the reference sample and the gas sample.

16. (Original) The method of claim 15, wherein step (a) further comprises placing the gas cell in an optical cavity.

17. (Original) The method of claim 15, wherein the gas sample is collected from expired human breath.

18. (Original) The method of claim 15, wherein the gas sample is collected from gas emissions from human skin.

19. (Original) The method of claim 18, wherein the step of collecting the gas sample further comprises:

(a) sealing a collection chamber having a first side with a planar opening by placing the first side firmly against skin;

(b) delivering into the collection chamber a steady flow of an inert gas; and

(c) collecting the gas sample from the collection chamber into the calorimetric gas cell.

20. (Original) The method of claim 15, wherein the specified component is ammonia.

21. (Original) The method of claim 15, wherein the specified component is nitric oxide.

22. (Original) The method of claim 15, wherein the specified component comprises a ketone.

23. (Original) The method of claim 15, wherein the specified component comprises an alcohol.

24. (Original) The method of claim 15, wherein the specified component comprises an alkane.

25. (Original) The method of claim 15, wherein said tunable optical radiation beam is multiplexed so that the beam may be passed through one or more of a plurality of gas cells.

26. (Original) The method of claim 25 further comprising detecting when a patient connects to one of the plurality of gas cells, said patient providing the gas sample.

27. (Original) The method of claim 25 further comprising notifying a patient when to connect to one of the plurality of gas cells, said patient providing the gas sample.

28. (Original) The method of claim 25 further comprising notifying the patient of a completed diagnosis after determining the concentration of the specified component.

29. (Original) The method of claim 25 further comprising the tunable optical radiation beam being simultaneously passes through at least two of the plurality of gas cells.

30. (Original) A diagnostic method for high sensitivity detection of component concentrations in human gas emissions comprising:

(a) collecting a gas sample in a calorimetric gas cell having an acoustic microphone within said calorimetric gas cell, wherein the gas sample may contain a specified component being associated with a plurality of fundamental absorption peak frequencies;

(b) passing a pulsed tunable optical radiation beam through the calorimetric gas cell when the calorimetric gas cell (1) contains a reference sample having a known concentration of the specified component and (2) contains the gas sample, wherein the tunable optical radiation beam has a frequency corresponding to one of the plurality of fundamental absorption peak frequencies;

(c) measuring, after the tunable optical radiation beam passes through the calorimetric gas cell, as first signal outputs an optoacoustic signal in the calorimetric gas cell detected by the acoustic microphone, and as second signal outputs a power of the tunable optical radiation beam; and

(d) determining a concentration of the specified component in the gas sample using the first signal outputs and the second signal outputs obtained from the reference sample and the gas sample.

31. (Original) The method of claim 30, wherein step (a) further comprises placing the calorimetric gas cell in an optical cavity.

32. (Original) The method of claim 30, wherein the gas sample is collected from expired human breath.

33. (Original) The method of claim 30, wherein the gas sample is collected from gas emissions from human skin.

34. (Original) The method of claim 33, wherein the step of collecting the gas sample further comprises:

(a) sealing a collection chamber having a first side with a planar opening by placing the first side firmly against skin;

(b) delivering into the collection chamber a steady flow of an inert gas; and

(c) collecting the gas sample from the collection chamber into the calorimetric gas cell.

35. (Original) The method of claim 30, wherein the specified component is ammonia.

36. (Original) The method of claim 30, wherein the specified component is nitric oxide.

37. (Original) The method of claim 30, wherein the specified component comprises a ketone.

38. (Original) The method of claim 30, wherein the specified component comprises an alcohol.

39. (Original) The method of claim 30, wherein the specified component comprises an alkane.

40. (Original) The method of claim 30, wherein said tunable optical radiation beam is multiplexed so that the beam may be passed through one or more of a plurality of calorimetric gas cells.

41. (Original) The method of claim 40 further comprising detecting when a patient connects to one of the plurality of gas cells, said patient providing the gas sample.

42. (Original) The method of claim 40 further comprising notifying a patient when to connect to one of the plurality of gas cells, said patient providing the gas sample.

43. (Original) The method of claim 40 further comprising notifying the patient of a completed diagnosis after determining the concentration of the specified component.

44. (Original) The method of claim 40 further comprising the tunable optical radiation beam being simultaneously passes through at least two of the plurality of gas cells.

45. (Currently amended) A skin gas detector comprising:

a collection chamber housing defining an interior space, said housing having a planar opening on a first side for enclosing and sealing the interior space against skin, a gas outlet on a second side, and a gas inlet on a third side;

an inert gas source connected to the gas inlet;

a gas cell connected to the gas outlet and to a vacuum pump so that the vacuum pump may pump gas from the interior space into the gas cell;

a tunable optical radiation beam directed through the gas cell; and

an energy absorption detection system to measure energy absorbed by the gas within the gas cell

wherein the gas cell comprises a calorimetric gas cell and the absorption detection system comprises:

a detector placed in the path of the optical radiation beam after the beam has emerged from the gas cell to detect the optical radiation beam and output a detected power as first signal outputs;

an acoustic microphone placed inside the gas cell to detect an optoacoustic signal within the gas cell and output the detected optoacoustic signal as second signal outputs; and

electronic circuitry communicably connected to the detector and to the microphone to measure the first and second signal outputs.

46. (Cancelled)

47. (Original) A method of delivering an optical radiation beam from a single source to a plurality of medical systems comprising the steps of:

(a) directing the optical radiation beam into a beam guide that branches into a plurality of endpoints;

(b) placing at each of the plurality of endpoints one of the plurality of medical systems to receive and utilize the optical radiation beam for diagnosis or treatment of a patient;

(c) monitoring the plurality of medical systems to determine beam utilization requirements of each of the plurality of medical systems;

(d) directing the optical radiation beam through the beam guide to one or more of the plurality of endpoints based on the beam utilization requirements of each of the plurality of medical systems;

48. (Original) The method of claim 47, step (c) further comprising detecting when a patient connects to one of the plurality of medical systems.

49. (Original) The method of claim 47, step (c) further comprising scheduling utilization times for each of the plurality of medical systems and notifying patients when the scheduled utilization time has arrived.

50. (Original) The method of claim 47, wherein the optical radiation beam may be simultaneously utilized by two or more of the plurality of medical systems.

51. (Original) The method of claim 47, comprising the additional step of notifying the patient that the diagnosis or treatment is completed.

52. (Original) A diagnostic method for high sensitivity detection of component concentrations in human gas emissions comprising:

(a) collecting a gas sample in a gas cell, wherein the gas sample may contain a specified component being associated with a plurality of fundamental absorption peak frequencies, and placing the gas cell in an optical cavity;

(b) passing, at distinct and different times, a tunable optical radiation beam at a first frequency and at a second frequency through the gas cell when the gas cell (1) contains a reference sample having a known concentration of the specified component, (2) does not contain the specified component, and (3) contains the gas sample, wherein the first frequency corresponds to one of the fundamental absorption peak frequencies and the second frequency does not correspond to one of the fundamental absorption peak frequencies;

(c) measuring, after the tunable optical radiation beam passes through the gas cell, as first signal outputs a power of the tunable optical radiation beam at the first frequency when the gas cell contains the reference sample, as second signal outputs the power of the tunable optical radiation beam at the second frequency when the gas cell contains the reference sample, as third signal outputs the power of the tunable optical radiation beam at the first frequency when the gas cell does not contain the specified component, as fourth signal outputs the power of the tunable optical radiation beam at the

second frequency when the gas cell does not contain the specified component, as fifth signal outputs the power of the tunable optical radiation beam at the first frequency when the gas cell contains the gas sample, and as sixth signal outputs the power of the tunable optical radiation beam at the second frequency when the gas cell contains the gas sample; and

(d) determining a concentration of the specified component in the gas sample using the following equation:

$$C = \text{constant1} * \frac{S_1(0) - S_1(SC)}{S_1(0)} * \frac{S_2(0)}{S_2(SC)},$$

where C corresponds to the concentration of the specified component, $S_1(0)$ corresponds to the third signal outputs, $S_2(0)$ corresponds to the fourth signal outputs, $S_1(SC)$ corresponds to the fifth signal outputs, $S_2(SC)$ corresponds to the sixth signal outputs, and constant1 is determined by solving the equation for constant1 and substituting the first signal outputs for $S_1(SC)$, the second signal outputs for $S_2(SC)$, and the known concentration of the reference sample for C.

53. (Original) A diagnostic method for high sensitivity detection of component concentrations in human gas emissions comprising:

(a) collecting a gas sample in a gas cell, wherein the gas sample may contain a specified component being associated with a plurality of fundamental absorption peak frequencies;

(b) passing a tunable optical radiation beam through the gas cell when the gas cell (1) contains a reference sample having a known concentration of the specified component and (2) contains the gas sample, wherein the frequency of the tunable optical radiation beam comprises a modulation frequency superimposed on a base frequency, and the base frequency is swept repeatedly through a series of frequencies such that the series of frequencies comprises at least one of the fundamental absorption peak frequencies;

(c) measuring, after the tunable optical beam passes through the gas cell, as first signal outputs an amplitude of the tunable optical radiation beam at the modulation frequency when the gas cell contains the reference sample, as second signal outputs a power of the tunable optical radiation beam when the gas cell contains the reference sample, as third signal outputs the amplitude of the tunable optical radiation beam at the

modulation frequency when the gas cell contains the gas sample, and as fourth signal outputs the power of the tunable optical radiation beam when the gas cell contains the gas sample; and

(d) determining a concentration of the specified component in the gas sample using the following equation:

$$C = \text{constant2} * \frac{S_{AC}(f_1, \omega)}{P(f_1)},$$

where C corresponds to the concentration of the specified component, f_1 corresponds to the at least one fundamental absorption peak frequency, ω corresponds to the modulation frequency, $S_{AC}(f_1, \omega)$ corresponds to the third signal outputs, $P_1(f_1)$ corresponds to the fourth signal outputs, and constant2 is determined by solving the equation for constant2 and substituting the first signal outputs for $S_{AC}(f_1, \omega)$, the second signal outputs for $P_1(f_1)$, and the known concentration of the reference sample for C.

54. (Original) A diagnostic method for high sensitivity detection of component concentrations in human gas emissions comprising:

(a) collecting a gas sample in a calorimetric gas cell having an acoustic microphone within said calorimetric gas cell, wherein the gas sample may contain a specified component being associated with a plurality of fundamental absorption peak frequencies;

(b) passing a pulsed tunable optical radiation beam through the calorimetric gas cell when the calorimetric gas cell (1) contains a reference sample having a known concentration of the specified component and (2) contains the gas sample, wherein the tunable optical radiation beam has a frequency corresponding to one of the fundamental absorption peak frequencies;

(c) measuring, after the tunable optical radiation beam passes through the calorimetric gas cell, as first signal outputs an optoacoustic signal in the calorimetric gas cell detected by the acoustic microphone when the gas cell contains the reference sample, as second signal outputs a power of the tunable optical radiation beam when the gas cell contains the reference sample, as third signal outputs the optoacoustic signal in the calorimetric gas cell detected by the microphone when the gas cell contains the gas

sample, and as fourth signal outputs the power of the tunable optical radiation beam when the gas cell contains the gas sample; and

(d) determining a concentration of the specified component in the gas sample using the following equation:

$$C = \text{constant3} * \frac{S_{AC}(f_1)}{P(f_1)},$$

where C corresponds to the concentration of the specified component, f_1 corresponds to the at least one fundamental absorption peak frequency, $S_{AC}(f_1)$ corresponds to the third signal outputs, $P_1(f_1)$ corresponds to the fourth signal outputs, and constant2 is determined by solving the equation for constant2 and substituting the first signal outputs for $S_{AC}(f_1)$, the second signal outputs for $P_1(f_1)$, and the known concentration of the reference sample for C.

55. (Original) A diagnostic method for high sensitivity detection of component concentrations in human gas emissions comprising:

(a) collecting a gas sample in a calorimetric gas cell having an acoustic microphone within said calorimetric gas cell, wherein the gas sample may contain a specified component being associated with a plurality of fundamental absorption peak frequencies;

(b) passing, at distinct and different times, a pulsed discretely tunable optical radiation beam at a first frequency and at a second frequency through the calorimetric gas cell when the calorimetric gas cell (1) contains a reference sample having a known concentration of the specified component and (2) contains the gas sample, wherein the first frequency is near a first of the fundamental absorption peak frequencies and the second frequency is not near any of the fundamental absorption peak frequencies;

(c) adjusting the pressure in the calorimetric gas cell to increase an absorption of the specified component at the first frequency;

(d) measuring, after the optical radiation beam passes through the calorimetric gas cell, as first signal outputs an optoacoustic signal in the calorimetric gas cell detected by the acoustic microphone when the optical radiation beam passes through the gas cell at the first frequency, as second signal outputs the power of the tunable optical radiation beam at the first frequency, as third signal outputs the optoacoustic signal in the

calorimetric gas cell detected by the acoustic microphone when the optical radiation beam passes through the gas cell at the second frequency, and as fourth signal outputs the power of the tunable optical radiation beam at the second frequency; and

(e) determining a concentration of the specified component in the gas sample using the first, second, third, and fourth signal outputs.

56. (Original) The method of claim 55, wherein:

step (b) further comprises passing the pulsed discretely tunable optical radiation beam at a third frequency through the calorimetric gas cell when the calorimetric gas cell (1) contains a reference sample having a known concentration of the specified component and (2) contains the gas sample, wherein the third frequency is near a second of the fundamental absorption peak frequencies that is different from the first fundamental absorption peak frequency;

step (d) further comprises measuring, after the optical radiation beam passes through the calorimetric gas cell, as fifth signal outputs the optoacoustic signal in the calorimetric gas cell detected by the acoustic microphone when the optical radiation beam passes through the gas cell at the third frequency, and as sixth signal outputs the power of the tunable optical radiation beam at the third frequency; and

step (d) further comprises verifying the concentration of the specified component in the gas sample using the third, fourth, fifth, and sixth signal outputs.

Respectfully submitted,

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